

## CLAIMS

What is claimed is:

1 1. A method of generating an output image based on a first image and a  
2 second image, the method comprising:  
3 determining whether a first display position on a display panel at  
4 which a first pixel of the output image is to be displayed is within an active  
5 display region of the display panel;  
6 performing active display processing if the first display position is  
7 within the active display region of the display panel; and  
8 performing blanking processing if the first display position is not  
9 within the active display region of the display panel.

1 2. The method of claim 1 wherein performing active display processing  
2 comprises:  
3 performing selective display processing if the first image and the  
4 second image are not both active at the first display position; and  
5 performing composite display processing if the first image and the  
6 second image are both active at the first display position.

1 3. The method of claim 2 wherein the first image is active at the first  
2 display position if the first display position is within a first display area to be  
3 occupied by the first image and wherein the second image is active at the first  
4 display position if the first display position is within a second display area to  
5 be occupied by the second image.

1 4. The method of claim 2 wherein performing selective display  
2 processing comprises:

3 selecting, as the first pixel of the output image, either a first pixel of the  
4 first image if only the first image is active at the first display position or a first  
5 pixel of the second image if only the second image is active at the first display  
6 position.

1 5. The method of claim 4 wherein the first pixel of the first image is a  
2 pixel of the first image whose display location corresponds to the first display  
3 position and wherein the first pixel of the second image is a pixel of the  
4 second image whose display location corresponds to the first display position.

1 6. The method of claim 2 wherein performing composite display  
2 processing comprises:

3 blending a first pixel of the first image with a first pixel of the second  
4 image to generate the first pixel of the output image.

1 7. The method of claim 6 wherein the first pixel of the first image is a  
2 pixel of the first image whose display location corresponds to the first display  
3 position and wherein the first pixel of the second image is a pixel of the  
4 second image whose display location corresponds to the first display position.

1 8. The method of claim 2 wherein performing composite display  
2 processing comprises:

3 selecting, as the first pixel of the output image, either a first pixel of the  
4 first image, a first pixel of the second image, or a blending of the first pixel of  
5 the first image and the first pixel of the second image, based upon a

6 processing control input, the processing control input indicating whether the  
7 first image is transparent or opaque, whether the second image is transparent  
8 or opaque, and whether the first image is on top of the second image.

1 9. The method of claim 8 wherein the processing control input comprises  
2 a first control signal, the first control signal is set if the first image is  
3 transparent and not set if the first image is opaque, a second control signal,  
4 the second control signal is set if the second image is transparent and not set if  
5 the second image is opaque, and a third control signal, the third control signal  
6 is set if the first image is on top of the second image and not set if the second  
7 image is on top of the first image.

1 10. The method of claim 9 wherein the first pixel of the first image is  
2 selected as the first pixel of the output image if the first control signal is not  
3 set and the third control signal is set.

1 11. The method of claim 9 wherein the first pixel of the second image is  
2 selected as the first pixel of the output image if the second control signal is not  
3 set and third control signal is not set.

1 12. The method of claim 9 wherein the blending of the first pixel of the  
2 first image and the first pixel of the second image is selected as the first pixel  
3 of the output image if both the first control signal and the second control  
4 signal are set.

1 13. The method of claim 9 wherein the blending of the first pixel of the  
2 first image and the first pixel of the second image is selected as the first pixel

3 of the output image if the first control signal is set and the third control signal  
4 is set.

1 14. The method of claim 9 wherein the blending of the first pixel of the  
2 first image and the first pixel of the second image is selected as the first pixel  
3 of the output image if the second control signal is set and the third control  
4 signal is not set.

1 15. The method of claim 8 wherein the blending of the first pixel of the  
2 first image and the first pixel of the second image is an alpha blending of the  
3 first pixel of the first image and the first pixel of the second image.

1 16. The method of claim 15 wherein the alpha blending comprises an  
2 alpha blending of a first component of the first pixel of the first image and a  
3 first component of the first pixel of the second image.

1 17. The method of claim 16 wherein the first component of the first pixel  
2 of the respective image is a chroma component indicative of a first  
3 characteristic of the first pixel or a luma component indicative of a second  
4 characteristic of the first pixel.

1 18. The method of claim 17 wherein the first characteristic is a color  
2 characteristic and the second characteristic is a brightness characteristic.

1 19. The method of claim 1 wherein the first image and the second image  
2 are selected from the group consisting of a digital video image, an analog  
3 video image, a graphics image, and a background color.

1 20. The method of claim 19 wherein the graphics image comprises a tiled  
2 graphics image.

1 21. The method of claim 19 wherein the graphics image comprises a cursor  
2 image.

1 22. The method of claim 1 wherein the output image is displayed on the  
2 display panel in an interlaced display mode.

1 23. The method of claim 1 wherein determining whether the first display  
2 position is within the active display region comprises:  
3 determining whether the display panel is in a blanking state, the first  
4 display position is within the active display region if the display panel is not  
5 in the blanking state.

1 24. The method of claim 23 wherein the display panel is in the blanking  
2 state if the display panel is in a vertical blanking period.

1 25. The method of claim 23 wherein the display panel is in the blanking  
2 state if the display panel is in a horizontal blanking period.

1 26. The method of claim 1 wherein performing blanking display  
2 processing comprises:  
3 generating, based upon a blanking control input, either a blank signal,  
4 an end of active video (EAV) signal, a start of active video (SAV) signal, a  
5 constant value, a previous output pixel, or a pixel of ancillary data.

1 27. The method of claim 26 wherein the ancillary data is a text data, a  
2 video data, or a graphics data.

1 28. A method of displaying an output image on a display panel, the  
2 method comprising:  
3 determining whether a first image and a second image are active at a  
4 current display location on the display panel;  
5 performing a first function if the first image and the second image are  
6 both active at the current display location; and  
7 performing a second function if the first image and the second image  
8 are not both active at the current display location.

1 29. The method of claim 28 wherein determining whether the first image  
2 and the second image are active comprises:  
3 determining whether the current display location is within a first  
4 display area to be occupied by the first image and a second display area to be  
5 occupied by the second image.

1 30. The method of claim 28 wherein performing the first function  
2 comprises:  
3 selecting, as the output image, either the first image if the first image is  
4 not transparent and to be displayed on top, the second image if the second  
5 image is not transparent and to be displayed on top.

1 31. The method of claim 30 further including:

2       blending the first image with the second image to generate the output  
3 image if the first image is transparent and to be on top, or the second image is  
4 transparent and to be on top.

1   32.   The method of claim 28 wherein performing the second function  
2 comprises:

3       selecting, as the output image, either the first image if the first image is  
4 active and the second image is not active at the current display location or the  
5 second image if the second image is active and the first image is not active at  
6 the current display location.

1   33.   A method of generating an output image from multiple input images,  
2 each input image being assigned a different relative overlaying display  
3 number with a lowest relative overlaying display number being assigned to a  
4 first input image that is to be displayed below all other input images at a  
5 current display position and a highest relative overlaying display number  
6 being assigned to a last input image that is to be displayed on top of all other  
7 input images at the current display position, the method comprising:

8       locating the current display position on a display screen where a  
9 current pixel of the output image is to be displayed;

10       indicating that there is currently no active input image to blend;

11       designating the first image as a current image; and

12       performing a first function with respect to the current image until all  
13 input images have been processed.

1   34.   The method of claim 33 wherein performing the first function  
2 comprises:

3 determining whether the current image is active at the current display  
4 position;  
5 performing a second function with respect to the current image if the  
6 current image is active at the first display position; and  
7 designating as the current image a next input image that has a next  
8 higher relative overlaying display number.

1 35. The method of claim 34 wherein performing the second function  
2 comprises:  
3 performing a third function with respect to the current image if there is  
4 currently at least one active image to blend; and  
5 if there is currently no active image to blend, selecting a current pixel of  
6 the current image as the current pixel of the output image and indicating that  
7 there is currently at least one active image to blend.

1 36. The method of claim 35 wherein performing the third function  
2 comprises:  
3 selecting the current pixel of the current image as the current pixel of  
4 the output image if the current image is not transparent; and  
5 if the current image is transparent, blending the current pixel of the  
6 current image with the current pixel of the output image to produce a current  
7 output data and redesignating the current output data as the current pixel of  
8 the output image.

1 37. A method of composing an output image to be displayed on a display  
2 panel based upon multiple input images, the multiple input images



3 comprising a first image, a second image, a third image and a fourth image,  
4 the method comprising:  
5       determining whether the display panel is in a blanking display mode at  
6 a first display location on the display panel, the first display location  
7 corresponding to a location on the display panel where a first output pixel is  
8 to be displayed;  
9       performing active display processing if the display panel is not in the  
10 blanking display mode; and  
11       performing blanking display processing if the display panel is in the  
12 blanking display mode.

1 38. The method of claim 37 wherein the first image comprises a  
2 background image being selected from the group consisting of a background  
3 color image, a background tiled graphics image, and a background video  
4 image.

1 39. The method of claim 37 wherein the second image comprises a video  
2 image.

1     40.     The method of claim 37 wherein the third image comprises a graphics  
2     image.

1 41. The method of claim 37 wherein the fourth image comprises a cursor  
2 image.

1  
2 42. The method of claim 37 wherein performing the active display  
3 processing comprises:

4 selecting as a first output data a first pixel of the second image if the  
5 second image is active at the first display location or the first pixel of the first  
6 image if the second image is not active at the first display location.

1 43. The method of claim 42 wherein the second image is active at the first  
2 display location if the first display location is within a second display area on  
3 the display panel that is to be occupied by the second image.

1 44. The method of claim 42 including:  
2 blending a first pixel of the third image with the first output data to  
3 generate a second output data if the third image is active at the first display  
4 location and the third image is transparent.

1 45. The method of claim 44 including:  
2 selecting as the second output data the first output data if the second  
3 image is active at the first display location and the second image is on top of  
4 the third image.

1 46. The method of claim 44 including:  
2 selecting as the second output data the first pixel of the third image if  
3 the third image is active at the first display location and the third image is not  
4 transparent.

1 47. The method of claim 46 including:  
2 blending a first pixel of the fourth image with the second output data to  
3 generate the first output pixel if the fourth image is active at the first display  
4 location and the fourth image is transparent;

5           selecting the first pixel of the fourth image as the first output pixel if  
6 the fourth image is active at the first display location and the fourth image is  
7 not transparent; and  
8           selecting the second output data as the first output pixel if the fourth  
9 image is not active at the first display location.

1   48.   The method of claim 37 wherein performing blanking display  
2 processing comprises:  
3           generating blanking data selected from the group consisting of a blank  
4 signal, a constant value, a start of active video (SAV) signal, an end of active  
5 video (EAV) signal, a previous output pixel, and ancillary data.

1   49.   The method of claim 48 wherein the ancillary data is selected from a  
2 text data, a video data, and a graphics data.

1   50.   A method of displaying a transparent cursor image on top of a first  
2 image, the method comprising:  
3           determining whether the cursor image is active at a current display  
4 location, the current display location corresponding to a display screen  
5 location where a current output pixel is to be displayed;  
6           if the cursor image is active at the current display location, blending a  
7 current pixel of the cursor image with a current pixel of the first image to  
8 generate the current output pixel; and  
9           selecting the current pixel of the first image as the current output pixel  
10 if the cursor image is not active at the current display location.

1 51. The method of claim 50 wherein the cursor image is active at the  
2 current display location if the current display location is located within a  
3 cursor display area on the display screen that is to be occupied by the cursor  
4 image.

1 52. The method of claim 50 wherein the current pixel of the cursor image  
2 is a pixel in the cursor image whose display location corresponds to the  
3 current display location and wherein the current pixel of the first image is a  
4 pixel in the first image whose display location corresponds to the current  
5 display location.

1 53. A method of compositing an output image, the method comprising:  
2 generating a display processing instruction based upon a display control  
3 input, the display control input being indicative of whether a current display  
4 location is in an active display area, whether a first input image and a second  
5 input image are active at the current display location, whether the first image  
6 and the second image are transparent, and whether the first image is to be on  
7 top of the second image; and  
8 performing a first function with respect to the first image and the  
9 second image to generate the output image according to the processing  
10 instruction.

1 54. The method of claim 53 wherein the processing instruction comprises:  
2 a first parameter, the first parameter is set to a first value if the current  
3 display location is in the active display area and set to a second value if the  
4 current display location is not in the active display area; and

5 a second parameter, the second parameter is set to a first value if only  
6 the first image is active and to second value if only the second image is active.

1 55. The method of claim 54 wherein the second parameter is set to the first  
2 value if the first image is active, not transparent and to be on top and set to  
3 the second value if the second image is active, not transparent and to be on  
4 top.

1 56. The method of claim 55 wherein the second parameter is set to a third  
2 value if the first image is active, transparent and to be on top or if the second  
3 image is active, transparent and to be on top.

1 57. The method of claim 56 wherein performing the first function  
2 comprises:  
3 selecting the first image to generate the output image if the first  
4 parameter is set to the first value and the second parameter is set to the first  
5 value.

1 58. The method of claim 56 wherein performing the first function  
2 comprises:  
3 selecting the second image to generate the output image if the first  
4 parameter is set to the first value and the second parameter is set to the  
5 second value.

1 59. The method of claim 56 wherein performing the first function  
2 comprises:

3       blending the first image and the second image to generate the output  
4 image if the first parameter is set to the first value and the second parameter  
5 is set to the third value.

1   60.   The method of claim 56 wherein performing the first function  
2 comprises:

3       generating a blanking data if the first parameter is set to the second  
4 value, the blanking data being selected from a group consisting of a constant  
5 value, a start of active video (SAV) code, an end of active video (EAV) code,  
6 and ancillary data.

1   61.   An apparatus for processing a first image and a second image to  
2 produce an output image for display on a display panel, the apparatus  
3 comprising:

4       an input coupled to receive the first image and the second image;  
5       a blend device to blend the first image and the second image to  
6 generate a blended output; and

7       a select device to select either the first image, the second image, or the  
8 blended output as the output image based upon a processing control input.

1   62.   The apparatus of claim 61 wherein the select device is further  
2 configured to select, as the output image, either the first image, the second  
3 image, the blended output, or a blank data based upon the processing control  
4 input.

1   63.   The apparatus of claim 61 wherein the processing control input  
2 comprises a first signal, the first signal is set to a first value if only the first

3 image is active at a current display location and the first signal is set to a  
4 second value if only the second image is active at the current display location.

1 64. The apparatus of claim 63 wherein the first signal is set to the first  
2 value if the first image is active, not transparent and to be on top and set to  
3 the second value if the second image is active, not transparent and to be on  
4 top.

1 65. The apparatus of claim 64 wherein the first signal is set to a third value  
2 if the first image is active, transparent and to be on top or if the second image  
3 is active, transparent and to be on top.

1 66. The apparatus of claim 65 wherein the select device is further  
2 configured to select, as the output image, either the first image if the first  
3 signal is set to the first value, the second image if the first signal is set to the  
4 second value, or the blended output if the first signal is set to the third value.

1 67. The apparatus of claim 62 wherein the select device selects the blank  
2 data if the processing control input is set to a fourth value, the processing  
3 control input being set to the fourth value if the display panel is in a blanking  
4 display mode.

1 68. An apparatus for processing multiple input images to produce an  
2 output image, the apparatus comprising:  
3 a first select device coupled to select either a background color image, a  
4 background graphics image, a background video image, or a scaled video  
5 image based upon a processing control input to generate a first layer output;

6 a first blending unit coupled to the first select device, the first blending  
7 unit configured to blend the first layer output with a graphics image to  
8 generate a second layer output based upon the processing control input; and  
9 a second blending unit coupled to the first blending unit, the second  
10 blending unit configured to blend the second layer output with a cursor  
11 image to generate the output image based upon the processing control input.

1 69. The apparatus of claim 68 further comprising:

2 a second select device coupled to the second blending unit, the second  
3 select device configured to select either the output image from the second  
4 blending unit or blank data based upon the processing control input to  
5 generate a final output.

1 70. The apparatus of claim 68 further comprising:

2 a graphics processor coupled to the first blending unit, the graphics  
3 processor configured to preprocess the graphics image before the graphics  
4 image is blended with the first layer output.

1 71. The apparatus of claim 68 further comprising:

2 a pixel synchronization unit to propagate the final output from a first  
3 clock domain to a second clock domain.

1 72. An apparatus for processing multiple input images to generate an  
2 output image for display on a display panel, the apparatus comprising:

3 a display control unit coupled to generate a display processing  
4 instruction for a current processing phase based upon display screen data and  
5 input parameters;



6 a display executing unit coupled to the display control unit and  
7 configured to generate processing control signals based upon the display  
8 processing instruction; and  
9 an arithmetic unit coupled to the display executing unit and configured  
10 to perform a first operation with respect to the input images based upon the  
11 processing control signals to generate an output data.

1 73. The apparatus of claim 72 wherein the display screen data comprises:  
2 a first screen data indicating whether the display panel is in a blanking  
3 display mode or an active display mode in the current processing phase, a  
4 second screen data indicating a current display position where a current pixel  
5 of the output image is to be displayed, the display control unit is further  
6 configured to use the first screen data and the second screen data to perform  
7 its corresponding function.

1 74. The apparatus of claim 72 wherein the input parameters comprise:  
2 display configuration information with respect to each input image,  
3 the display configuration information indicating a display size of the  
4 respective input image, and a display location of the respective input image,  
5 whether the respective input image is to be displayed on top of or below other  
6 input images if the respective input image and other input images occupy the  
7 same display location on the display panel, the display control unit further  
8 configured to use the display configuration information to perform its  
9 corresponding function.

1 75. The apparatus of claim 72 wherein the display processing instruction  
2 comprises:

3 a first control signal indicating whether blanking data or active data is  
4 to be generated in the current processing phase; a second control signal  
5 indicating which type of blanking data is to be used if the first control signal  
6 indicates that blanking data is to be generated; a third control signal indicating  
7 whether the respective input images are to be blended or to be selected  
8 individually to generate the output image, and if the respective input images  
9 are to be blended, an order in which the respective input images are to be  
10 blended, the display executing unit further configured to use the first, second,  
11 and third control signals to perform its corresponding function.

1 76. The apparatus of claim 72 wherein the display processing selection  
2 signals comprise:

3 a first selection signal indicating which of the input sources are to be  
4 used as a first operand and a second operand in a first level blending  
5 operation, a second selection signal indicating which of the input sources are  
6 to be used as the first operand and the second operand in a second level  
7 blending operation, the arithmetic unit further configured to use the first and  
8 second selection signals to perform its corresponding function.

1 77. The apparatus of claim 72 wherein the first operation comprises a  
2 selection operation and a blending operation.

1 78. The apparatus of claim 72 including:

2 a storage device coupled to the display executing unit and the  
3 arithmetic unit, the storage device configured to store a first amount of pixel  
4 data from the input images and intermediate results from the arithmetic  
5 unit.

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1 79. A method of generating a tiled graphics image from a first tile, the first  
2 tile comprising a first number of rows, each row comprising a first number of  
3 pixels, the method comprising:  
4 in response to a first signal indicating that a beginning of a new display  
5 field has been detected, generating a first memory address that corresponds to  
6 the first pixel in the first row of the first tile;  
7 performing a first operation comprising:  
8 fetching the first number of pixels stored in memory  
9 locations starting at the first memory address into a buffer  
10 having a predetermined buffer size;  
11 displaying sequentially the first number of pixels stored in  
12 the buffer on a first display line of a screen until the end of the  
13 first display line is reached;  
14 in response to a second signal indicating that a beginning  
15 of a new display line has been detected, updating the first  
16 memory address to a next memory location that corresponds to  
17 the first pixel in a next display row of the tile, the next display  
18 row being the previously displayed row plus a predetermined  
19 number; and  
20 repeating the first operation until a signal indicating a new display field  
21 has been detected.

1 80. A method for generating a tiled graphics image from a tile bitmap, the  
2 tile bitmap storing a first number of rows of pixels, each row of pixels  
3 comprising a second number of pixels, the tile bitmap being stored in a first  
4 memory device, the method comprising:

5 detecting a signal indicating a beginning of a display line on a display  
6 screen;  
7 generating a memory address corresponding to a current pixel of a  
8 current row in the tile bitmap;  
9 fetching a first amount of pixels stored in the tile bitmap, starting from  
10 the memory address, from the first memory device into an on-chip buffer;  
11 and  
12 displaying, in a specified order, each pixel stored in the on-chip buffer  
13 on the display line until a first condition is detected.

1 81. The method of claim 80 wherein the location of the current row in the  
2 tile bitmap is determined based upon a vertical offset input.

1 82. The method of claim 81 wherein the vertical offset input indicates a  
2 number of rows in the tile bitmap that is to be skipped based upon a starting  
3 address.

1 83. The method of claim 82 wherein the starting address corresponding to  
2 the first row in the tile bitmap;

1 84. The method of claim 80 wherein the location of the current pixel of the  
2 current row in the tile bitmap is determined based upon a horizontal offset  
3 input.

1 85. The method of claim 84 wherein the horizontal offset input indicates a  
2 number of columns in the tile bitmap that is to be skipped.

1 86. The method of claim 80 wherein generating the memory address  
2 comprises:  
3 generating a current line address corresponding to a memory line  
4 location of the current row in the tile bitmap; and  
5 generating a current horizontal address corresponding to a location of  
6 the current pixel in the current row.

1 87. The method of claim 86 wherein generating the current line address  
2 comprises:  
3 generating an initial line address if the display line on the screen is the  
4 first display line within a current display field; and  
5 updating the initial display line address to a next line address based  
6 upon a vertical tiling control input if the display line on the screen is not the  
7 first display line within the current display field.

1 88. The method of claim 87 wherein the initial address line is computed  
2 based upon a display area control input.

1 89. The method of claim 88 wherein the display area control input  
2 comprises a starting address, a vertical offset input and a signal indicating  
3 whether a field mismatch has been detected.

1 90. The method of claim 87 wherein the vertical tiling control input  
2 comprises a vertical reversed tiling flag indicating whether tiling is to be  
3 performed in a reversed vertical direction.

1 91. The method of claim 86 wherein generating the current horizontal  
2 address corresponding to the location of the current pixel comprises:  
3 determining whether the on-chip buffer is large enough to store one  
4 row of pixels in the tile bitmap;  
5 if the on-chip buffer is large enough, setting the current horizontal  
6 address to be the same as the current line address;  
7 if the on-chip buffer is not large enough, setting the horizontal address  
8 to be the line address plus a horizontal offset input, the horizontal offset  
9 input indicating the number of columns in the tile that is to be skipped.

1 92. The method of claim 80 wherein fetching the first amount of pixels  
2 comprises:  
3 fetching the entire current row of pixels into the on-chip buffer if the  
4 on-chip buffer is large enough to hold the entire current row of pixels; and  
5 performing a partial memory to on-chip buffer fetching operation if the  
6 on-chip buffer is not large enough to hold the entire current row of pixels.

1 93. The method of claim 80 wherein displaying each pixel stored in the on-  
2 chip buffer comprises:  
3 determining whether a horizontal reversed tiling flag is set;  
4 performing a first displaying operation if the horizontal reversed tiling  
5 flag is not set;  
6 performing a second displaying operation if the horizontal reversed  
7 tiling flag is set.

1 94. The method of claim 93 wherein performing the first display operation  
2 comprises:

